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Appl. No. 09/938,205
Amdt. dated Friday, September 24, 2004
Reply to Official Action of June 25, 2004

Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

Claims 1-4. (canceled)

Claim 5. (currently amended) ~~The process of claim 3 wherein the base metal is a nickel alloy selected from the group consisting of nickel-manganese, nickel-aluminum, nickel-silver, nickel-bronze and nickel-silicon~~ A process of manufacturing a metal sheet precoated with an antimicrobial polymer coating, comprising:

providing a metal sheet substrate provided as a continuous strip having two opposed planar surfaces and comprising a nickel alloy base metal selected from the group consisting of nickel manganese, nickel-aluminum, nickel silver, nickel bronze and nickel-silicon;

cleaning the surface of the substrate with an alkaline solution comprising one or more agents selected from the group consisting of caustic soda, soda ash, alkaline silicates, sodium hydroxide, sodium carbonate, sodium metasilicate, phosphates, alkaline builders, ammonium acid phosphate, ammonium hydroxide, monoethanol amine, and dimethylamine oxide wherein cleaning comprises removing bulk and molecular organic contaminants;

pretreating at least one planar surface of the substrate to promote adhesion of a polymer coating;

applying a polymer coating onto at least one planar surface of the substrate by roll coating the substrate with a polymer containing an anti-microbial powder comprising

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core particles associated with an antimicrobial metal component;

wherein the content of the antibiotic powder is in the range of from about 0.2 to about 30 weight percent of the polymeric coating;

wherein the core particle comprises one or more particles selected from the group consisting of: oxides selected from the group consisting of titanium, aluminum, zinc and copper oxides, sulfates selected from the group consisting of calcium, strontium and barium sulfates, sulfides selected from the group consisting of zinc and copper sulfides, zeolites, zirconium phosphate, mica, talc, kaolin, mullite, silica and mixtures thereof;

wherein the antimicrobial metal component is selected from the group consisting of silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions and mixtures thereof; and

treating the coated substrate to produce at least a partially hardened and adhered antimicrobial coating on the final sheet product.

Claim 6. (currently amended) ~~The process of claim 3 wherein the base metal is~~ A process of manufacturing a metal sheet precoated with an antimicrobial polymer coating, comprising:

providing a metal sheet substrate provided as a continuous strip having two opposed planar surfaces and comprising a base metal selected from the group selected from the group consisting essentially of copper alloys, brass, bronze, silicon bronze, silicon brass, nickel silver and nickel bronze;

cleaning the surface of the substrate with an alkaline solution comprising one or more agents selected from the group consisting of caustic soda, soda ash, alkaline silicates, sodium hydroxide, sodium carbonate, sodium metasilicate, phosphates, alkaline builders, ammonium acid phosphate, ammonium hydroxide, monoethanol amine, and

dimethylamine oxide wherein cleaning comprises removing bulk and molecular organic contaminants;

pretreating at least one planar surface of the substrate to promote adhesion of a polymer coating;

applying a polymer coating onto at least one planar surface of the substrate by roll coating the substrate with a polymer containing an anti-microbial powder comprising core particles associated with an antimicrobial metal component;

wherein the content of the antibiotic powder is in the range of from about 0.2 to about 30 weight percent of the polymeric coating;

wherein the core particle comprises one or more particles selected from the group consisting of: oxides selected from the group consisting of titanium, aluminum, zinc and copper oxides, sulfates selected from the group consisting of calcium, strontium and barium sulfates, sulfides selected from the group consisting of zinc and copper sulfides, zeolites, zirconium phosphate, mica, talc, kaolin, mullite, silica and mixtures thereof;

wherein the antimicrobial metal component is selected from the group consisting of silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions and mixtures thereof; and

treating the coated substrate to produce at least a partially hardened and adhered antimicrobial coating on the final sheet product.

Claim 7. (canceled)

Claim 8. (currently amended) ~~The process of claim 7 wherein the base metal is~~ A process of manufacturing a metal sheet precoated with an antimicrobial polymer coating, comprising:

providing a metal sheet substrate provided as a continuous strip having two opposed

planar surfaces and comprising an aluminum alloy base metal selected from the group consisting of Al-Cl, Al-Mg, Al-Si, Al-Cu-Ni-Mg and Al-Si-Cu-Ni-Mg;

cleaning the surface of the substrate with an alkaline solution comprising one or more agents selected from the group consisting of caustic soda, soda ash, alkaline silicates, sodium hydroxide, sodium carbonate, sodium metasilicate, phosphates, alkaline builders, ammonium acid phosphate, ammonium hydroxide, monoethanol amine, and dimethylamine oxide wherein cleaning comprises removing bulk and molecular organic contaminants;

pretreating at least one planar surface of the substrate to promote adhesion of a polymer coating;

applying a polymer coating onto at least one planar surface of the substrate by roll coating the substrate with a polymer containing an anti-microbial powder comprising core particles associated with an antimicrobial metal component;

wherein the content of the antibiotic powder is in the range of from about 0.2 to about 30 weight percent of the polymeric coating;

wherein the core particle comprises one or more particles selected from the group consisting of: oxides selected from the group consisting of titanium, aluminum, zinc and copper oxides, sulfates selected from the group consisting of calcium, strontium and barium sulfates, sulfides selected from the group consisting of zinc and copper sulfides, zeolites, zirconium phosphate, mica, talc, kaolin, mullite, silica and mixtures thereof;

wherein the antimicrobial metal component is selected from the group consisting of silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions and mixtures thereof; and

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treating the coated substrate to produce at least a partially hardened and adhered antimicrobial coating on the final sheet product

Claims 9-22. (canceled)

Claim 23. (currently amended) ~~The process of claim 21 wherein~~ A process of manufacturing a metal sheet precoated with an antimicrobial polymer coating, comprising:

providing a metal sheet substrate having two opposed planar surfaces comprising a base metal selected from the group consisting of aluminum, iron, nickel, titanium, molybdenum, magnesium, manganese, copper, silver, lead, tin, chromium, beryllium, tungsten, cobalt and alloys thereof;

cleaning the surface of the substrate with an alkaline solution comprising one or more agents selected from the group consisting of caustic soda, soda ash, alkaline silicates, sodium hydroxide, sodium carbonate, sodium metasilicate, phosphates, alkaline builders, ammonium acid phosphate, ammonium hydroxide, monoethanol amine, and dimethylamine oxide wherein cleaning comprises removing bulk and molecular organic contaminants;

pretreating at least one planar surface of the substrate to promote adhesion of a polymer coating wherein the pretreating creates a chemical conversion interlayer coating formed by contacting the metal with an aqueous phosphating composition comprising phosphoric acid and a divalent metal ion wherein the composition has a total phosphate content from about 0.01 to about 3 moles/liter and the divalent metal ion is selected from the group consisting of Mg, Ca, Sr, and Ba;

applying a polymer coating onto at least one planar surface of the substrate by roll coating the substrate with a polymer containing an anti-microbial powder comprising core particles associated with an antimicrobial metal component;

wherein the content of the antibiotic powder is in the range of from about 0.2 to about 30 weight percent of the polymeric coating;

wherein the core particle comprises one or more particles selected from the group consisting of: oxides selected from the group consisting of titanium, aluminum, zinc and copper oxides, sulfates selected from the group consisting of calcium, strontium and barium sulfates, sulfides selected from the group consisting of zinc and copper sulfides, zeolites, zirconium phosphate, mica, talc, kaolin, mullite, silica and mixtures thereof;

wherein the antimicrobial metal component is selected from the group consisting of silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions and mixtures thereof; and

treating the coated substrate to produce at least a partially hardened and adhered antimicrobial coating on the final sheet product.

Claims 24-28. (canceled)

Claim 29. (currently amended) ~~The process of claim 21~~ A process of manufacturing a metal sheet precoated with an antimicrobial polymer coating, comprising:

providing a metal sheet substrate having two opposed planar surfaces comprising a base metal selected from the group consisting of aluminum, iron, nickel, titanium, molybdenum, magnesium, manganese, copper, silver, lead, tin, chromium, beryllium, tungsten, cobalt and alloys thereof wherein the metal substrate is predominantly galvanized steel or steel;

cleaning the surface of the substrate with an alkaline solution comprising one or more agents selected from the group consisting of caustic soda, soda ash, alkaline silicates, sodium hydroxide, sodium carbonate, sodium metasilicate, phosphates, alkaline builders, ammonium acid phosphate, ammonium hydroxide, monoethanol amine, and

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dimethylamine oxide wherein cleaning comprises removing bulk and molecular organic contaminants;

pretreating at least one planar surface of the substrate to promote adhesion of a polymer coating wherein the pretreating creates a chemical conversion interlayer coating formed by contacting the metal with an aqueous phosphating composition comprising phosphoric acid and a divalent metal ion wherein the composition has a total phosphate content from about 0.01 to about 3 moles/liter and wherein the phosphating composition includes boric acid in an amount of at least 0.02 moles/liter;

applying a polymer coating onto at least one planar surface of the substrate by roll coating the substrate with a polymer containing an anti-microbial powder comprising core particles associated with an antimicrobial metal component;

wherein the content of the antibiotic powder is in the range of from about 0.2 to about 30 weight percent of the polymeric coating;

wherein the core particle comprises one or more particles selected from the group consisting of: oxides selected from the group consisting of titanium, aluminum, zinc and copper oxides, sulfates selected from the group consisting of calcium, strontium and barium sulfates, sulfides selected from the group consisting of zinc and copper sulfides, zeolites, zirconium phosphate, mica, talc, kaolin, mullite, silica and mixtures thereof;

wherein the antimicrobial metal component is selected from the group consisting of silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions and mixtures thereof; and

treating the coated substrate to produce at least a partially hardened and adhered antimicrobial coating on the final sheet product.

Claims 30-52. (canceled)

Claim 53. (currently amended) ~~The process of claim 44~~ A process of manufacturing a metal sheet precoated with an antimicrobial polymer coating, comprising:

providing a metal sheet substrate having two opposed planar surfaces comprising a base metal selected from the group consisting of aluminum, iron, nickel, titanium, molybdenum, magnesium, manganese, copper, silver, lead, tin, chromium, beryllium, tungsten, cobalt and alloys thereof;

cleaning the surface of the substrate with an alkaline solution comprising one or more agents selected from the group consisting of caustic soda, soda ash, alkaline silicates, sodium hydroxide, sodium carbonate, sodium metasilicate, phosphates, alkaline builders, ammonium acid phosphate, ammonium hydroxide, monoethanol amine, and dimethylamine oxide wherein cleaning comprises removing bulk and molecular organic contaminants;

pretreating at least one planar surface of the substrate to promote adhesion of a polymer coating wherein the pretreating creates a chemical conversion interlayer coating formed by contacting the metal with a composition selected from the group consisting of chromium phosphate, chromium chromate, zinc phosphate, iron phosphate, or an epoxy;

applying a polymer coating onto at least one planar surface of the substrate by roll coating the substrate with a polymer containing an anti-microbial powder comprising core particles associated with an antimicrobial metal component wherein the polymer is selected from the group consisting of acrylic resins, polyester resins, polyethylene, polypropylene, epoxy resins, polyurethane resins, olefin resins, polyamide resins, ethylene-vinyl acetate copolymer, ethylene-vinyl alcohol copolymer, polyvinyl chloride, polyvinylidene chloride, polystyrene, ABS resin, polyethylene terephthalate, nylon, polycarbonate and copolymers, terpolymers and mixtures thereof;

wherein the content of the antibiotic powder is in the range of from about 0.2 to about 30 weight percent of the polymeric coating;

wherein the core particle comprises one or more particles comprising a synthetic zeolite selected from the group consisting of A-type zeolite, X-type zeolite, Y-type zeolite, and mordenite having ion-exchangeable ions partially ion-exchanged with antibiotic metal ions in an amount less than about 90% of the ion-exchangeable saturation capacity of the zeolite particles, wherein the ion-exchangeable ions are selected from the group consisting of sodium ions, potassium ions, calcium ions, magnesium ions and iron ions and wherein the antibacterial metals ions are selected from the group consisting of silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions or mixtures thereof, and wherein the zeolite particles retain the antibacterial metal ions at ionic exchange sites of the zeolite in an amount less than the ion exchange saturation capacity of the zeolite

wherein the zeolite is ion-exchanged with one or more additional metal ions selected from the group consisting of silica, silicates, silicon dioxide, borosilicates, aluminosilicates, alumina, aluminum phosphate, zinc, zinc oxide, zinc silicate, copper, copper oxide, and mixtures thereof;

wherein the antimicrobial metal component is selected from the group consisting of silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions and mixtures thereof; and

treating the coated substrate to produce at least a partially hardened and adhered antimicrobial coating on the final sheet product.

Claim 54. (previously presented)The process of claim 53 wherein the additional metal ions comprise from about 0.1 to about 20% by weight, based on anhydrous zeolite plus metal.

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Claim 55. (currently amended) ~~The process of claim 44~~ A process of manufacturing a metal sheet precoated with an antimicrobial polymer coating, comprising:

providing a metal sheet substrate having two opposed planar surfaces comprising a base metal selected from the group consisting of aluminum, iron, nickel, titanium, molybdenum, magnesium, manganese, copper, silver, lead, tin, chromium, beryllium, tungsten, cobalt and alloys thereof;

cleaning the surface of the substrate with an alkaline solution comprising one or more agents selected from the group consisting of caustic soda, soda ash, alkaline silicates, sodium hydroxide, sodium carbonate, sodium metasilicate, phosphates, alkaline builders, ammonium acid phosphate, ammonium hydroxide, monoethanol amine, and dimethylamine oxide wherein cleaning comprises removing bulk and molecular organic contaminants;

pretreating at least one planar surface of the substrate to promote adhesion of a polymer coating wherein the pretreating creates a chemical conversion interlayer coating formed by contacting the metal with a composition selected from the group consisting of chromium phosphate, chromium chromate, zinc phosphate, iron phosphate, or an epoxy;

applying a polymer coating onto at least one planar surface of the substrate by roll coating the substrate with a polymer containing an anti-microbial powder comprising core particles associated with an antimicrobial metal component wherein the polymer is selected from the group consisting of acrylic resins, polyester resins, polyethylene, polypropylene, epoxy resins, polyurethane resins, olefin resins, polyamide resins, ethylene-vinyl acetate copolymer, ethylene-vinyl alcohol copolymer, polyvinyl chloride, polyvinylidene chloride, polystyrene, ABS resin, polyethylene terephthalate, nylon, polycarbonate and copolymers, terpolymers and mixtures thereof;

wherein the content of the antibiotic powder is in the range of from about 0.2 to about 30 weight percent of the polymeric coating;

wherein the core particle comprises one or more particles comprising a synthetic zeolite selected from the group consisting of A-type zeolite, X-type zeolite, Y-type zeolite, and mordenite having ion-exchangeable ions partially ion-exchanged with antibiotic metal ions in an amount less than about 90% of the ion-exchangeable saturation capacity of the zeolite particles, wherein the ion-exchangeable ions are selected from the group consisting of sodium ions, potassium ions, calcium ions, magnesium ions and iron ions and wherein the antibacterial metals ions are selected from the group consisting of silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions or mixtures thereof, and wherein the zeolite particles retain the antibacterial metal ions at ionic exchange sites of the zeolite in an amount less than the ion exchange saturation capacity of the zeolite

wherein the antimicrobial metal component is selected from the group consisting of silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions and mixtures thereof;

wherein the antimicrobial powder is additionally coated with a dispersion enhancing coating selected from the group consisting of resin, hydrous metal oxide, and mixtures thereof; and

treating the coated substrate to produce at least a partially hardened and adhered antimicrobial coating on the final sheet product.

Claims 56-64. (canceled)

Claim 65. (currently amended) ~~The process of claim 64~~ A process of manufacturing a metal sheet precoated with an antimicrobial polymer coating, comprising:

providing a metal sheet substrate having two opposed planar surfaces comprising a base metal selected from the group consisting of aluminum, iron, nickel, titanium, molybdenum, magnesium, manganese, copper, silver, lead, tin, chromium, beryllium, tungsten, cobalt and alloys thereof;

cleaning the surface of the substrate by deoxidizing the surface by immersion in an acid solution, and rinsing in water;

pretreating at least one planar surface of the substrate to promote adhesion of a polymer coating wherein the pretreating creates a chemical conversion interlayer coating formed by contacting the metal with a composition selected from the group consisting of chromium phosphate, chromium chromate, zinc phosphate, iron phosphate, or an epoxy;

applying a polymer coating onto at least one planar surface of the substrate by two-roll roll coating the substrate with a polymer containing an anti-microbial powder comprising core particles associated with an antimicrobial metal component wherein the polymer is selected from the group consisting of acrylic resins, polyester resins, polyethylene, polypropylene, epoxy resins, polyurethane resins, olefin resins, polyamide resins, ethylene-vinyl acetate copolymer, ethylene-vinyl alcohol copolymer, polyvinyl chloride, polyvinylidene chloride, polystyrene, ABS resin, polyethylene terephthalate, nylon, polycarbonate and copolymers, terpolymers and mixtures thereof;

wherein the content of the antibiotic powder is in the range of from about 0.2 to about 30 weight percent of the polymeric coating;

wherein the core particle comprises one or more particles comprising a synthetic zeolite selected from the group consisting of A-type zeolite, X-type zeolite, Y-type zeolite, and mordenite having ion-exchangeable ions partially ion-exchanged with antibiotic metal ions in an amount less than about 90% of the ion-exchangeable

saturation capacity of the zeolite particles, wherein the ion-exchangeable ions are selected from the group consisting of sodium ions, potassium ions, calcium ions, magnesium ions and iron ions and wherein the antibacterial metals ions are selected from the group consisting of silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions or mixtures thereof, and wherein the zeolite particles retain the antibacterial metal ions at ionic exchange sites of the zeolite in an amount less than the ion exchange saturation capacity of the zeolite;

wherein the antimicrobial metal component is selected from the group consisting of silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions and mixtures thereof; and

treating the coated substrate to produce at least a partially hardened and adhered antimicrobial coating on the final sheet product by a method selected from the group consisting of heat, infrared radiation, fluorescent radiation, ultraviolet radiation, gamma or beta radiation, X-ray radiation, or combinations thereof.

Claims 66-73. (canceled)

Claim 74. (previously presented) A process of manufacturing a metal sheet precoated with an antimicrobial polymer coating, comprising:

providing a metal sheet substrate having two opposed planar surfaces comprising a base metal wherein the base metal is a nickel alloy selected from the group consisting of nickel manganese, nickel-aluminum, nickel silver, nickel bronze and nickel-silicon;

cleaning the surface of the substrate wherein cleaning comprises removing bulk and molecular organic contaminants;

pretreating at least one planar surface of the substrate to promote adhesion of a

polymer coating;

applying a polymer coating onto at least one planar surface of the substrate by roll coating the substrate with a polymer containing an anti-microbial powder comprising core particles associated with an antimicrobial metal component;

wherein the content of the antibiotic powder is in the range of from about 0.2 to about 30 weight percent of the polymeric coating;

wherein the core particle comprises one or more particles selected from the group consisting of: oxides selected from the group consisting of titanium, aluminum, zinc and copper oxides, sulfates selected from the group consisting of calcium, strontium and barium sulfates, sulfides selected from the group consisting of zinc and copper sulfides, zeolites, zirconium phosphate, mica, talc, kaolin, mullite, silica and mixtures thereof;

wherein the antimicrobial metal component is selected from the group consisting of silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions and mixtures thereof; and

treating the coated substrate to produce at least a partially hardened and adhered antimicrobial coating on the final sheet product.

Claim 75. (previously presented) A process of manufacturing a metal sheet precoated with an antimicrobial polymer coating, comprising:

providing a metal sheet substrate having two opposed planar surfaces comprising a base metal selected from the group consisting of aluminum, iron, nickel, titanium, molybdenum, magnesium, manganese, copper, silver, lead, tin, chromium, beryllium, tungsten, cobalt and alloys thereof;

cleaning the surface of the substrate wherein cleaning comprises removing bulk and molecular organic contaminants;

pretreating at least one planar surface of the substrate to promote adhesion of a polymer coating wherein the pretreating creates a chemical conversion interlayer coating formed by contacting the metal with an aqueous phosphating composition comprising phosphoric acid and a divalent metal ion selected from the group consisting of Mg, Ca, Sr, and Ba;

applying a polymer coating onto at least one planar surface of the substrate by roll coating the substrate with a polymer containing an anti-microbial powder comprising core particles associated with an antimicrobial metal component;

wherein the content of the antibiotic powder is in the range of from about 0.2 to about 30 weight percent of the polymeric coating;

wherein the core particle comprises one or more particles selected from the group consisting of: oxides selected from the group consisting of titanium, aluminum, zinc and copper oxides, sulfates selected from the group consisting of calcium, strontium and barium sulfates, sulfides selected from the group consisting of zinc and copper sulfides, zeolites, zirconium phosphate, mica, talc, kaolin, mullite, silica and mixtures thereof;

wherein the antimicrobial metal component is selected from the group consisting of silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions and mixtures thereof; and

treating the coated substrate to produce at least a partially hardened and adhered antimicrobial coating on the final sheet product.

Claim 76. (previously presented) A process of manufacturing a metal sheet precoated with an antimicrobial polymer coating, comprising:

providing a metal sheet substrate having two opposed planar surfaces comprising a base metal selected from the group consisting of aluminum, iron, nickel, titanium,

molybdenum, magnesium, manganese, copper, silver, lead, tin, chromium, beryllium, tungsten, cobalt and alloys thereof;

cleaning the surface of the substrate wherein cleaning comprises removing bulk and molecular organic contaminants;

pretreating at least one planar surface of the substrate to promote adhesion of a polymer coating;

applying a polymer coating onto at least one planar surface of the substrate by roll coating the substrate with a polymer containing an anti-microbial powder comprising core particles associated with a first and second antimicrobial metal component and wherein the core particles retain the first antibacterial metal ions at ionic exchange sites of the particles;

wherein the content of the antibiotic powder is in the range of from about 0.2 to about 30 weight percent of the polymeric coating;

wherein the core particle comprises one or more particles selected from the group consisting of: oxides selected from the group consisting of titanium, aluminum, zinc and copper oxides, sulfates selected from the group consisting of calcium, strontium and barium sulfates, sulfides selected from the group consisting of zinc and copper sulfides, zeolites, zirconium phosphate, mica, talc, kaolin, mullite, silica and mixtures thereof;

wherein the first antimicrobial metal component is selected from the group consisting of silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions thereof;

wherein the second antimicrobial metal component is at least one metal selected from the group consisting of silica, silicates, silicon dioxide, borosilicates, aluminosilicates, alumina, aluminum phosphate, zinc, zinc oxide, zinc silicate,

copper, copper oxide, and mixtures thereof; and

treating the coated substrate to produce at least a partially hardened and adhered antimicrobial coating on the final sheet product.

Claim 77. (previously presented) A process of manufacturing a metal sheet precoated with an antimicrobial polymer coating, comprising:

providing a metal sheet substrate having two opposed planar surfaces comprising a base metal selected from the group consisting of aluminum, iron, nickel, titanium, molybdenum, magnesium, manganese, copper, silver, lead, tin, chromium, beryllium, tungsten, cobalt and alloys thereof;

cleaning the surface of the substrate wherein cleaning comprises deoxidizing the surface by immersion in an acid solution, and rinsing in water;

pretreating at least one planar surface of the substrate to promote adhesion of a polymer coating;

applying a polymer coating onto at least one planar surface of the substrate by roll coating the substrate with a polymer containing an anti-microbial powder comprising core particles associated with an antimicrobial metal component;

wherein the content of the antibiotic powder is in the range of from about 0.2 to about 30 weight percent of the polymeric coating;

wherein the core particle comprises one or more particles selected from the group consisting of: oxides selected from the group consisting of titanium, aluminum, zinc and copper oxides, sulfates selected from the group consisting of calcium, strontium and barium sulfates, sulfides selected from the group consisting of zinc and copper sulfides, zeolites, zirconium phosphate, mica, talc, kaolin, mullite, silica and mixtures thereof;

wherein the antimicrobial metal component is selected from the group consisting of

silver, copper, zinc, mercury, tin, lead, bismuth, cadmium, chromium, cobalt, nickel, and thallium ions and mixtures thereof; and

treating the coated substrate to produce at least a partially hardened and adhered antimicrobial coating on the final sheet product.